Work stress and reduced health in young physicians: prospective evidence from Swiss residents

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Abstract: Objectives: Job stress investigated by the effort-reward model in various working environments in different countries has been widely reported, yet studies addressing physicians are lacking. The present study investigated the perceived job stress, its association with the amount of working hours, and its impact on young physicians' self-reported health and their satisfaction with life during residency. Methods: In a prospective study design a cohort of Swiss medical school graduates was followed up, beginning in 2001. In their second and fourth years of residency, 433 physicians assessed their effort-reward imbalance, overcommitment, physical and mental well-being and satisfaction with life. Taking the longitudinal design into account, four categories of stressed residents were defined: (1) subjects not reporting high work stress at either measurement, (2) subjects reporting high work stress in the second but not in the fourth year of residency, (3) subjects with onset of high work stress in fourth year, and (4) residents reporting high work stress at both measurements. Results: All components of the perceived stress at work were significantly correlated with the amount of working hours, effort showing the highest correlation. While two thirds of the participants do not report high work stress, assessed by the extrinsic part of the effort-reward imbalance model (the ratio between effort and reward) and 12% show a decrease of stress over time, there are 15% with an increase of stress over time, and 10% with persistently high stress experience. In terms of the intrinsic stress component (overcommitment), 71% show low values, 12% show a decrease, 9% an increase, and 8% constantly high values. The groups with constant and increasing extrinsic and intrinsic stress experience exhibit significantly worse health and life satisfaction compared to the remaining groups, after controlling for gender and baseline health. Conclusions: Stress at work in young physicians, especially when being experienced over a longer period in postgraduate training, has to be a matter of concern because of its negative impact on health and life satisfaction and the risk of developing symptoms of burnout in the long run. Keywords: Effort-reward imbalance; overcommitment; work stress; reduced health; residents; longitudinal study.

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Work stress and reduced health in young physicians: prospective evidence from Swiss residents

Barbara Buddeberg-Fischer[*1], Richard Klaghofer[1], Martina Stamm[1], Johannes Siegrist[2], Claus Buddeberg[1]

Address: [1]Department of Psychosocial Medicine, Zurich University Hospital, Haldenbachstrasse 18, CH-8091 Zurich, Switzerland and [2] Institute of Medical Sociology, Heinrich Heine University Dusseldorf, D-40001 Dusseldorf, Germany

[*]Corresponding author:

Prof. Dr. med. Barbara Buddeberg-Fischer

E-mail: barbara.buddeberg@usz.ch;

Tel.: 0041-44-255 51 27

Fax: 0041-44-255 43 84

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Abstract

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Methods: In a prospective study design a cohort of Swiss medical school graduates was followed up, beginning in 2001. In their second and fourth years of residency, 433 physicians assessed their effort-reward imbalance, overcommitment, physical and mental well-being and satisfaction with life. Taking the longitudinal design into account, four categories of stressed residents were defined: (1) subjects not reporting high work stress at either measurement, (2) subjects reporting high work stress in the second but not in the fourth year of residency, (3) subjects with onset of high work stress in fourth year, and (4) residents reporting high work stress at both measurements.

Results: All components of the perceived stress at work were significantly correlated with the amount of working hours, effort showing the highest correlation. While two thirds of the participants do not report high work stress, assessed by the extrinsic part of the effort-reward imbalance model (the ratio between effort and reward) and 12% show a decrease of stress over time, there are 15% with an increase of stress over time, and 10% with persistently high stress experience. In terms of the intrinsic stress component (overcommitment), 71% show low values, 12% show a decrease, 9% an increase, and 8% constantly high values. The groups with constant and increasing extrinsic and intrinsic stress experience exhibit significantly worse health and life

satisfaction compared to the remaining groups, after controlling for gender and baseline health.

Conclusions: Stress at work in young physicians, especially when being experienced over a longer period in postgraduate training, has to be a matter of concern because of its negative impact on health and life satisfaction and the risk of developing symptoms of burnout in the long run.

Keywords: Effort-reward imbalance; overcommitment; work stress; reduced health; residents; longitudinal study.

Introduction

Several studies report on doctors' postgraduate training being very stressful with a negative impact on physical and mental well-being and life satisfaction (Buddeberg-Fischer, Klaghofer, Abel and Buddeberg 2005; Buddeberg-Fischer, Klaghofer and Buddeberg 2005; Buddeberg-Fischer, Klaghofer, Zivanovic, Vetsch and Buddeberg 2006; Cohen and Patten 2005; Collier, McCue, Markus and Smith 2002; Levey 2001; Rockenbauch, Meister, Schmutzer and Alfermann 2006; Shanafelt, Bradley, Wipf and Back 2002; Tyssen, Vaglum, Groenvold and Ekeberg 2000). Since Siegrist formulated the model of effort-reward imbalance at work (ERI) in 1986 (J. Siegrist 1996; J. Siegrist, Siegrist and Weber 1986; J. Siegrist, Starke, Chandola, Godin, Marmot, Niedhammer and Peter 2004), a wide range of studies has indicated that the effort-reward imbalance is a valid instrument for evaluating a stressful working environment (Tsutsumi and Kawakami 2004; Unterbrink, Hack, Pfeifer, Buhl-Griesshaber, Müller, Wesche, Frommhold, Scheuch, Seibt, Wirsching and Bauer 2007). The central tenet of the ERI model is that an imbalance between (high) efforts and (low) rewards leads to (sustained) strain reactions. The ERI model contains three assumptions: (1) the *extrinsic component* of the ERI hypothesis: high efforts in

combination with low rewards increase the risk of poor health, (2) the *intrinsic component* of the overcommitment hypothesis: a high level of overcommitment (i.e. a personality characteristic) may increase the risk of poor health, and (3) the *interaction hypothesis*: employees reporting an extrinsic effort-reward imbalance and a high level of overcommitment have an even higher risk of poor health. Most studies using the ERI model investigate the relationship of effort-reward imbalance and employee health in a cross-sectional design (de Jonge, Bosma, Peter and Siegrist 2000; Godin and Kittel 2004; Kageyama, Matsuzaki, Morita, Sasahara, Satoh and Nakamura 2001; Kudielka, Hanebuth, von Känel, Gander, Grande and Fischer 2005; Larisch, Joksimovic, von dem Knesebeck, Starke and Siegrist 2003; Niedhammer, Teck, Starke and Siegrist 2004; Pikhart, Bobak, Pajak, Malyutina, Kubinova, Topor, Sebakova, Nikitin and Marmot 2004; Preckel, von Känel, Kudielka and Fischer 2005; Rockenbauch et al. 2006), some also in a longitudinal design (Godin, Kittel, Coppieters and Siegrist 2005; Mika Kivimäki, Leino-Arjas, Luukkonen, Riihimäki, Vahtera and Kirjonen 2002; Kuper, Sing-Manoux, Siegrist and Marmot 2002; Ostry, Hershler, Chen and Hertzman 2004; Stansfeld, Bosma, Hemingway and Marmot 1998; Stansfeld, Fuhrer, Shipley and Marmot 1999). All studies support the hypothesis that adverse working conditions elicit sustained stress reactions with negative long-term consequences for health. However, the interaction of effort-reward imbalance and overcommitment and its influence on employees' health has been scarcely examined.

Most studies investigate the relationship between work stress and cardiovascular disease (Peter and Siegrist 2000; van Vegchel, de Jonge, Bosma and Schaufeli 2005), some between ERI and burnout (Unterbrink et al. 2007); only a few report data on anxiety and depression (Godin and Kittel 2004; Godin et al. 2005; Larisch et al. 2003; Pikhart et al. 2004). As far as we know, only two cross-sectional studies report the

perceived effort-reward imbalance in physicians and their self-reported health (Li, Yang and Cho 2006; Rockenbauch et al. 2006). In the Chinese physicians' study (Li et al. 2006), ERI was found to be strongly associated with impaired health functioning. In the German graduate student study (Rockenbauch et al. 2006), alumni of medical sciences report lower life satisfaction than alumni of other faculties, mainly caused by the low leisure time and low financial reward. Longitudinal data in physicians are lacking to date.

In a cohort of Swiss residents, followed up over a two-year time period, *the following hypotheses* are to be tested: (1) There is a positive correlation between working hours and stress experience measured by the extrinsic component of the effort-reward imbalance model (ERI) and the intrinsic component (overcommitment, OVC) respectively. (2) Persistently high ERI and OVC values respectively have a negative influence on the participants' health. (3) There is an interaction effect between the extrinsic part of the model (ERI) and the intrinsic one (OVC) in terms of negative influence on the participants' health outcome.

Methods

Study design, sample development, and study sample

The present study is part of an ongoing prospective survey of a cohort of graduates of the three medical schools in German speaking Switzerland, beginning in 2001 (T_1). All of the 1004 registered final-year students were sent a letter explaining the study design, accompanied by a recommendation letter of the deans of the three medical schools, and the baseline questionnaire; the students' addresses were provided by the university boards. To ensure participants' anonymity, the returned questionnaires are only identified by a code. The respondents send their addresses to an independent address-administration office, allowing for follow-up. By filling in and returning the questionnaire to the research group and their address to a separate study

administration office the subjects gave their informed consent to participate in the study and to be followed-up.

The study protocol was approved by the ethical committee of Zurich university.

In the first assessment (T_1, in 2001), 715 graduates participated (Buddeberg-Fischer, Klaghofer, Abel and Buddeberg 2003). Subjects were re-evaluated after two years in 2003 (T_2) (Buddeberg-Fischer et al. 2005; Buddeberg-Fischer et al. 2006). The present paper refers to results of the second (T_2) and third assessment (T_3); the latter was conducted in the participants' fourth year of residency (in 2005).

The *study sample* consists of 433 residents (233 females, 53.8%; 200 males, 46.2%) participating at T_1, T_2 and T_3. The mean age at T_3 is 31.3 years (SD 2.4y). Of the residents 357 (82.6%) have a stable partnership, of whom 103 are married (48 females, and 55 males). Only 19 (8%) of the females, but 32 (16%) of the males have children (Fisher's Exact Test, $p = 0.01$). The mean working hours per week are 55.1 hrs (SD 7.6 hrs).

There are no significant differences between the dropouts (T_1– T_3) and the 433 subjects participating at all three measurements with regard to socio-demographic data, personality traits, and career-related variables at T_1. Whether the drop-outs would differ from the study sample at the third assessment (T_3), cannot be answered, neither the reasons why they do no longer participate in the study.

Instruments

In the following, it is described what constructs are measured by the applied instruments. All instruments are *self-assessment scales*, Cronbach's alpha values are given for the present study. The scale values were only calculated, if less than 20% of the items were missing. The missing values were substituted by the means of the answered items.

- *Questions concerning socio-demographic data*
- *Working hours per week*
- *Effort-Reward Imbalance at Work Questionnaire ERI-Q (Fragebogen zu beruflichen Gratifikationskrisen,* five-point Likert scales*)* (Siegrist et al. 2004): The 5 items of the *effort* scale measure extrinsic components of stressful experience at work such as psychological and physical job demands and/or obligations that are imposed on the employee (Cronbach's alpha 0.78). The 11 items of the *reward* scale measure extrinsic components of occupational rewards distributed by the employer consisting of money, esteem, and job security/career opportunities (Cronbach's alpha 0.78). The effort/reward ratio is a measure of the imbalance between these two components. A value close to zero indicates a favourable condition (relatively low effort, relatively high reward), whereas values above 1.0 indicate a high amount of expended effort not equalled by the rewards received or expected in return. In this study, we followed the convention of data analysis concerning the grouping of the effort-reward ratio as reported in several other studies (Dragano, Verde and Siegrist 2005; Godin and Kittel 2004; Godin et al. 2005; M Kivimäki, Vahtera, Elovainio, Virtanen and Siegrist 2007; Kuper et al. 2002; Niedhammer et al. 2004). According to this convention, subjects in the upper quartile of the ratio were defined as exposed to stressful work in terms of the effort-reward imbalance model (Dragano et al. 2005).
- *Overcommitment OVC* (Siegrist et al. 2004) (6 items, four-point Likert scale) is part of the Effort-Reward Imbalance at Work Questionnaire (Cronbach's alpha 0.73). It focuses on the intrinsic or personal component of the model which stands for a specific, individual pattern of coping with the various job demands and eliciting rewards. It reflects a respondent's (in)ability to withdraw from work obligations and develop a more distant attitude towards job requirements.

- *Hospital Anxiety and Depression Scale – German Version HADS-D* (Herrmann, Buss and Snaith 1995) contains 14 items on a four-point response scale, summed up to separate scores on anxiety (7 items; Cronbach's alpha 0.78) and depression (7 items; Cronbach's alpha 0.81); scale scores < 8 are in the normal range, 8-10 indicate possible psychiatric morbidity, and > 10 probable mood disorder.
- *Life Satisfaction Questionnaire LSQ (Fragebogen zur Lebenszufriedenheit FLZ)*(Henrich and Herschbach 2000) is a measure that assesses aspects of importance of and satisfaction with 8 life areas (friends/acquaintances, leisure/hobbies, health**,** income/financial security, study/work, living situation, family life/children and partnership/sex) (Cronbach's alpha 0.78). Items are evaluated on a 5-point scale according to (1) degree of importance of these spheres for life satisfaction and (2) satisfaction with these life areas. "General life satisfaction" is calculated from the individual scores for "importance" and "satisfaction".
- *Physical and mental well-being* are rated on a 7-point Likert scale from very bad (1) to very good (7). Wording of the question: "How do you assess your physical / mental well-being within the last four weeks?"

Statistical analyses

Formation of groups depending on the ratio between effort and reward, and overcommitment values

In order to evaluate the dynamics of stressful experiences at work over time, the sample is divided into four groups based on the ratio between *effort and reward* scores (ERI), according to the above described convention of data analysis (Dragano

et al. 2005; Godin and Kittel 2004; Godin et al. 2005; Kivimäki et al. 2007; Kuper et al. 2002; Niedhammer et al. 2004).

- *Group A* is composed of residents who do not report high work stress at both measurements (scores on the ERI ratio were lower than those in the upper quartile).
- In *group B*, there are subjects with high work stress present at second but not at fourth year of residency.
- Conversely, in *group C* there are subjects with experience of high work stress in fourth year but not in second.
- Finally, *group D* is composed of residents reporting high work stress at both measurements.

The same procedure of grouping is conducted with the *overcommitment* (OVC) scores: *group A*: not high OVC scores at T2 and T3; *group B*: not high OVC scores at T2, but high OVC scores at T3; conversely, *group C*: high OVC scores at T2, not high OVC scores at T3; and finally *group D*: high levels of OVC at both measurements. Thus we have two between subject factors (ERI and OVC stress groups) each with four categories (Group A, B, C, and D).

Data analysis

A power analysis - considering a medium effect size of f = 0.25 - revealed that the number of subjects in the described groups should reach at least n = 45. Thus a two-tailed significance testing will reach a test power of 0.80 (gold standard). The size of the groups, established by the described forming of the groups, achieved this condition.

All analyses are carried out with SPSS for windows, release 12.0 (SPSS Inc., Chicago, Ill.). Descriptive statistics are given in terms of counts and percentages,

means and standard deviations respectively. Objective 1 is analyzed by computing Pearson correlations, objective 2 and 3 by multivariate and univariate analyses of covariance with ERI and OVC stress groups as independent variables, physical and mental health as dependent variables, and gender and measurements at baseline as covariates. Bonferroni was used to adjust for multiple comparisons.

Results

Stress groups based on the Effort-reward imbalance / overcommitment model

As described in the method section, the sample is divided into four groups based on the ratio between effort and reward scores (ERI), and also into four groups based on the overcommitment (OVC) mean score. Subjects scoring in the upper quartile either of the ratio between effort and reward or the overcommitment scale are considered to experience high stress at work. Subjects in group A do not report high stress at either measurement, whereas residents in group B show high stress in their second year of residency and not in their fourth year. Group C subjects suffer from incident stress in their fourth year of residency. Residents assigned to group D feel continuously stressed at work.

In Table 1 the means and standard deviations of the ERI and the OVC values at T2 and T3 are listed for the four stress groups. By definition, participants assigned to group A show the lowest values, and those of group D the highest ones.

[Table 1]

Stress experience and working hours

The association between stress experience measured by the effort-reward imbalance model and the amount of working hours is investigated. All stress components show significant correlations with the amount of working hours: the effort scale: $r = 0.34$ ($p < 0.001$), the reward scale: $r = -0.11$ ($p = 0.032$), the ERI quotient: $r = 0.29$ ($p < .001$), and the overcommitment scale: $r = 0.23$ ($p < 0.001$). Albeit all correlations are

significant, the residents' expended effort shows the highest correlation with the working hours.

Effects of perceived stress on physical and mental health and life satisfaction

In a further step, the impact of experienced *effort-reward imbalance* on the subjects' physical and mental health is examined. As listed in Table 2a, residents experiencing incident (group C) or continuous (group D) stress at work show a significantly less favourable health outcome compared to group A and B. In groups C and D, 23% show sub-clinical anxiety and 14-16% clinically relevant anxiety disorder, 14% reveal symptoms of sub-clinical depression and 8% (group C) and 20% (group D) respectively have clinically relevant depression. The residents in groups C and D also assess their satisfaction with life and their physical and mental well-being significantly lower than those in the A and B groups. The multivariate analysis of covariance indicates a significant influence of the ratio between effort and reward on health outcome, even after controlling for gender and measurements at baseline.

[Table 2a]

Similar results emerge for the *stress groups based on overcommitment values* (Table 2b). Residents in groups C and D show a significantly worse health outcome in all variables than those in the groups A and B. The percentage of (sub)clinical mood disorders is even higher than in the effort-reward based stress groups C and D. The multivariate analysis of covariance indicates a significant influence of the overcommitment on health outcome, even after controlling for gender and measurements at baseline .

[Table 2b]

Overlap and interaction between effort-reward stress groups and overcommitment stress groups

At first, the cross-tabulation between ERI and OVC stress groups is shown in Table 3. There is a significant overlap between the two groups. Furthermore, we conducted a

2-factorial analysis of covariance with the independent variables effort-reward stress groups and overcommitment stress groups, the dependent variables self-reported health and the covariates gender and self-reported health at baseline. All interactions between the two independent variables are not significant in regard to health outcome (all p-values > 0.30). This means that ERI and OVC only have an additive effect on the residents' health outcome ($p < 0.001$), and not an additional effect by combination of the extrinsic (ERI) and the intrinsic (OVC) stress factor.

[Table 3]

Discussion

The present study is part of an ongoing prospective survey of a cohort of graduates of the three medical schools in German-speaking Switzerland, beginning in 2001 (T1) (Buddeberg-Fischer et al. 2003). To our knowledge, this is the first prospective study investigating the influence of work stress caused by effort-reward imbalance and overcommitment on young physicians' health and satisfaction with life. The paper reports data of the second (T2) and third (T3) assessments conducted in the participants' second (T2 in 2003) and fourth (T3 in 2005) years of residency. (At T1, the ERI model was not applied because the items are not suitable for students.) 433 young physicians participated in all three assessments. That is 60.6% of the initial study sample at T1 (N = 715). Compared to other longitudinal studies in medicine (Abele 2005; Stiller and Busse 2006) the participation rate has to be considered fairly high. A comparison between study participants and drop outs was only possible for baseline data, revealing no significant differences.

Perceived stress in residency

Residency is known to be a stressful time, especially during the first year (Levey 2001; Rockenbauch et al. 2006). Junior physicians lack clinical experience, have difficulty in establishing the doctor-patient-relationship and often struggle with the

administrative demands of their work, too (Jungbauer, Alfermann, Kamenik and Brähler 2003; Jungbauer, Kamenik, Alfermann and Brähler 2004; Levey 2001). In our study sample, 10% of the alumni perceive an imbalance between the expended effort and the received reward at work, scoring in the upper quartile at both assessments. Medical students and residents tend to be very dedicated to the demands of their profession and caring for patients (Rockenbauch et al. 2006). However, some of them seem to be overcommitted in a way, that they have difficulties to get away from patient issues and job demands suffering from sleeping problems and neglecting social contacts. In our study, 7% of the participants scored in the upper quartile of the overcommitment scale at both measurements. In the cross-sectional German study (Rockenbauch et al. 2006), 50% of the medical alumni report suffering from time pressure, 40% cannot get away from thinking of the performance of their duties, and 30% have sleeping problems.

Stress experience and working hours

All components of the ERI model showed significant correlations with the amount of working hours, the expended effort having the strongest contribution. I.e. residents perceive work stress not only dependent on the amount of working hours, but also on high job demands to be carried out in a short time. In some hospitals residents are not well supervised and have to carry a high responsibility for patient care. According to a general contract of residents' employment, implemented in Switzerland in 2000, full-time employed residents should not work more than 50 hours per week. Regardless, many residents are obliged to work overtime, in some specialties up to 80 hours per week. All these efforts spent at work are often not compensated by adequate rewards, i.e. professional acknowledgement, career support and promotion. Same findings are reported in the German medical alumni study (Rockenbauch et al. 2006): 70% have a

high amount of monthly overtime, and 50% are on weekend and night duty 4 to 8 times per month. The working conditions in Switzerland are not much different.

Work stress and self-reported health

According to other studies from different cultural backgrounds and professions (Godin and Kittel 2004; Godin et al. 2005; Kageyama et al. 2001; Larisch et al. 2003; Li et al. 2006; Niedhammer et al. 2004; Pikhart et al. 2004; Preckel et al. 2005; Rockenbauch et al. 2006), we also found a strong relationship between stress at work measured by the ERI model and self-reported health. It is a matter of concern that ongoing stress at work leads to serious physical and mental problems, especially symptoms of anxiety disorder and depression and low satisfaction with life in young physicians. These symptoms can be interpreted as first signs of burnout (Tyssen and Vaglum 2002; Tyssen et al. 2000). In the cross-sectional Chinese study (Li et al. 2006), also strong and consistent effects with regard to ERI for the physical and mental health indicators were found; these effects were even stronger than in the demand-control-support model (Karasek, Brisson, Kawakami, Houtman, Bongers and Amick 1998).

The same negative effect on health is seen in highly overcommitted residents. Other authors also report that employees characterized by high overcommitment have a multiple elevated risk of suffering from various (psycho)somatic symptoms than their less overcommitted colleagues (Head, Kivimäki, Siegrist, Ferrie, Vahtera, Shipley and Marmot 2007; Joksimovic, Starke, von dem Knesebeck and Siegrist 2002; Kuper et al. 2002; Larisch et al. 2003; Li et al. 2006). Highly stressed and/or overcommitted residents are more likely to experience vital exhaustion and dissatisfaction which might lead to difficulties in pursuing their chosen professional career (Preckel et al. 2005; Unterbrink et al. 2007). Overcommitted and stressed residents might have more difficulties establishing a good doctor-patient relationship, a factor which again

contributes to feeling stressed (Jungbauer et al. 2003; Jungbauer et al. 2004; Langewitz, Conen, Nübling and Weber 2002). Furthermore, stressed doctors have a negative influence on the atmosphere at their workplace; an unfavourable working atmosphere is again a factor for feeling stressed at work (Karasek and Theorell 1990). The German medical alumni study (Rockenbauch et al. 2006) reports that overcommitment in residents explains the greatest percentage of life satisfaction (in a negative sense), even more than effort-reward imbalance, instrumentality and occupational self-efficacy expectation.

Interaction of ERI and OVC stress groups

The hypothesis of an interaction between effort-reward imbalance and overcommitment could not be confirmed in our study: the effects of effort-reward imbalance and overcommitment are only additive, overcommitment having the greater influence on health and satisfaction with life. De Jonge et al. (2000) found that risks of an effort-reward imbalance were aggravated for highly overcommitted employees, whereas Kuper et al. (2002) and Van Vegchel, de Jonge, Meijer, & Hamers (2001) found no evidence for a moderating effect of overcommitment on the relation between effort-reward and (psycho)somatic symptoms. As there are no other prospective studies of perceived work stress assessed by the effort-reward and overcommitment scales in medicine, the data in our study cannot easily be compared with studies conducted among people in other professions.

Conclusions

The results of our prospective study confirm the hyopothesis that the number of working hours is related to the perceived work stress caused by an imbalance between effort and reward. Effort-reward imbalance and overcommitment are strong predictors for physical and mental health as well as for satisfaction with life in young physicians. These findings should be a matter of concern as they might be first signs of burnout.

The interaction effect between effort-reward imbalance and overcommitment could not be confirmed in the present study.

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References

Abele AE (2005) Karriereverläufe und Berufserfolg bei Medizinerinnen. In: Dettmer S, Kaczmarczyk G, Bühren A (eds) Karriereplanung für Ärztinnen. Springer, Heidelberg, pp 35-57

Buddeberg-Fischer B, Klaghofer R, Abel T, Buddeberg C (2003) The influence of gender and personality traits on the career planning of medical students. Swiss Med Wkly 133: 535-540

Buddeberg-Fischer B, Klaghofer R, Abel T, Buddeberg C (2005) Junior physicians' workplace experiences in clinical fields in German-speaking Switzerland. Swiss Med Wkly 135(1-2): 19-26

Buddeberg-Fischer B, Klaghofer R, Buddeberg C (2005) Arbeitsstress und gesundheitliches Wohlbefinden junger Ärztinnen und Ärzte. Z Psychosom Med Psychother 51(2): 163-178

Buddeberg-Fischer B, Klaghofer R, Zivanovic I, Vetsch E, Buddeberg C (2006) Institutional conditions and individual experiences in the career-entry period of Swiss medical residents - a qualitative study. Swiss Med Wkly 136(1-2): 26-32

Cohen JS, Patten S (2005) Well-being in residency training: a survey examining resident physician satisfaction both within and outside of residency training and mental health in Alberta. BMC Med Educ 5(21)

Collier VU, McCue JD, Markus A, Smith L (2002) Stress in medical residency: Status quo after a decade of reform. Ann Intern Med 136: 384-367

de Jonge J, Bosma H, Peter R, Siegrist J (2000) Job strain, effort-reward imbalance and employee well-being: a large-scale cross-sectional study. Soc Sci Med 50: 1317-1327

Dragano R, Verde P, Siegrist J (2005) Organizational downsizing and work stress: testing synergistic health effects in employed men and women. J Epidemiol Community Health 59: 694-699

Godin I, Kittel F (2004) Differential economic stability and psychosocial stress at work: associations with psychosomatic complaints and absenteeism. Soc Sci Med 58: 1543-1553

Godin I, Kittel F, Coppieters Y, Siegrist J (2005) A prospective study of cumulative job stress in relation to mental health. BMC Public Health 5(67)

Head J, Kivimäki M, Siegrist J, Ferrie JE, Vahtera J, Shipley MJ, et al. (2007) Effort-reward imbalance and relational injustice at work predict sickness absence: The Whitehall II study. J Psychosom Res 63: 433-440

Henrich G, Herschbach P (2000) Questions on Life Satisfaction (FLZ). A short questionnaire for assessing subjective quality of life. EJPA 16: 150-159

Herrmann C, Buss U, Snaith RP (1995) Hospital Anxiety and Depression Scale - Deutsche Version. Ein Fragebogen zur Erfassung von Angst und Depressivität in der somatischen Medizin. Testdokumentation und Handanweisung. Huber, Bern, Göttingen, Toronto, Seattle

Joksimovic L, Starke D, von dem Knesebeck O, Siegrist J (2002) Perceived work stress, overcommitment, and self-reported musculoskeletal pain: a cross-sectional investigation. Int J Behav Med 9(2): 122-138

Jungbauer J, Alfermann D, Kamenik C, Brähler E (2003) Vermittlung psychosozialer Kompetenzen mangelhaft. Psychother Psychosom Med Psychol 53: 319-321

Jungbauer J, Kamenik C, Alfermann D, Brähler E (2004) Wie bewerten angehende Ärzte rückblickend ihr Medizinstudium? Ergebnisse einer Absolventenbefragung. Gesundheitswesen 66: 51-56

Kageyama T, Matsuzaki I, Morita N, Sasahara S-I, Satoh S, Nakamura H (2001) Mental health of scientific researchers I. Characteristics of job stress among scientific researchers working at a research park in Japan. Int Arch Occup Environ Health 74: 199-205

Karasek R, Brisson C, Kawakami N, Houtman I, Bongers P, Amick B (1998) The job content questionnaire (JCQ): An instrument for internationally comparative assessments of psychosocial job characteristics. J Occup Health Psychol 3: 322-355

Karasek R, Theorell T (1990) Healthy work: stress, productivity and the reconstruction of working life. New York Basic Books, New York

Kivimäki M, Leino-Arjas P, Luukkonen R, Riihimäki H, Vahtera J, Kirjonen J (2002) Work stress and risk of cardiovascular mortality: prospective cohort study of industrial employees. BMJ 325: 857-861

Kivimäki M, Vahtera J, Elovainio M, Virtanen M, Siegrist J (2007) Effort-reward imbalance, procedural injustice and relational injustice as psychosocial predictors of health: complementary or redundant models? Occup Environ Med Jan 25

Kudielka BM, Hanebuth D, von Känel R, Gander M-L, Grande G, Fischer J (2005) Health-related quality of life measured by the SF12 in working populations: Associations with psychosocial work characteristics. J Occup Health Psychol 10(4): 429-440

Kuper H, Sing-Manoux A, Siegrist J, Marmot M (2002) When reciprocity fails: effort-reward imbalance in relation to coronary heart disease and health functioning within the Whitehall II study. Occup Environ Med 59(11): 777-784

Langewitz W, Conen D, Nübling M, Weber H (2002) Kommunikation ist wesentlich - Defizite in der Betreuung im Krankenhaus aus der Sicht von Patienten und Patientinnen. Psychother Psych Med 52: 348-354

Larisch M, Joksimovic L, von dem Knesebeck O, Starke D, Siegrist J (2003) Berufliche Gratifikationskrisen und depressive Symptome: eine Querschnittstudie bei Erwerbstätigen im mittleren Erwachsenenalter. Psychother Psychosom Med Psychol 53: 223-228

Levey RE (2001) Sources of stress for residents and recommendations for programs to assist them. Acad Med 76(2): 142-150

Li J, Yang W, Cho S (2006) Gender differences in job strain, effort-reward imbalance, and health functioning among Chinese physicians. Soc Sci Med 62(5): 1066-1077

Niedhammer I, Teck ML, Starke D, Siegrist J (2004) Effort-reward Imbalance Model and self reported health: Cross-sectional and prospective results from the GAZEL Cohort. Soc Sci Med 58(8): 1531-1541

Ostry AS, Hershler R, Chen L, Hertzman C (2004) A longitudinal study comparing the effort-reward imbalance and demand-control models using objective measures of physician utilization. Scand J Public Health 32(6): 456-463

Peter R, Siegrist J (2000) Psychosocial work environment and the risk of coronary heart disease. Int Arch Occup Environ Health 73(Supplement): S41-S45

Pikhart H, Bobak M, Pajak A, Malyutina S, Kubinova R, Topor R, et al. (2004) Psychosocial factors at work and depression in three countries of Central and Eastern Europe. Soc Sci Med 58: 1475-1482

Preckel D, von Känel R, Kudielka BM, Fischer JE (2005) Overcommitment to work is associated with viatl exhaustion. Int Arch Occup Environ Health 78: 117-122

Rockenbauch K, Meister U, Schmutzer G, Alfermann D (2006) Lebenszufriedenheit von AbsolventInnen der Medizin. Eine empirische Untersuchung zum Vergleich der Lebenszufriedenheit von AbsolventInnen mit Gleichaltrigen sowie zur Aufklärung des faktors Lebenszufriedenheit. (Alumni of medical sciences and their life satisfaction). Gesundheitswesen 68(3): 176-184

Shanafelt TD, Bradley KA, Wipf JE, Back AL (2002) Burnout and self-reported patient care in an internal medicine residency program. Ann Intern Med 136: 358-367

Siegrist J (1996) Soziale Krisen und Gesundheit. Hogrefe, Göttingen

Siegrist J, Siegrist K, Weber I (1986) Sociological concepts in the etiology of chronic disease: the case of ischemic heart disease. Soc Sci Med 22: 247-253

Siegrist J, Starke D, Chandola T, Godin I, Marmot M, Niedhammer I, et al. (2004) The measurement of effort-reward imbalance at work: European comparisons. Soc Sci Med 58: 1483-1499

Stansfeld SA, Bosma H, Hemingway H, Marmot MG (1998) Psychosocial work characteristics and social support as predictors of SF-36 health functioning: the Whitehall II study. Psychosom Med 60(3): 247-255

Stansfeld SA, Fuhrer R, Shipley MJ, Marmot MG (1999) Work characteristics predict psychiatric disorder: prospective results from the Whitehall II Study. Occup Environ Med 56(5): 302-307

Stiller J, Busse C (2006) Berufliche Entwicklung von Ärztinnen und Ärzten. "Schade, dass ein so schöner Beruf so zunichte gemacht werden kann!" Ergebnisse aus dem formel.1-Projekt-69. Medizinische Fakultät, Universität Leipzig, Abteilung für Medizinische Psychologie und Medizinische Soziologie, Leipzig

Tsutsumi A, Kawakami N (2004) A review of empirical studies on the model of effort-reward imbalance at work: reducing occupational stress by implementing a new theory. Soc Sci Med 59: 2335-2359

Tyssen R, Vaglum P (2002) Mental health problems among young doctors: an updated review of prospective studies. Harv Rev Psychiatry 10(3): 154-165

Tyssen R, Vaglum P, Groenvold NT, Ekeberg O (2000) The impact of job stress and working conditions on mental health problems among junior house officers. A nationwide Norwegian prospective cohort study. Med Educ 34(5): 374-384

Unterbrink T, Hack A, Pfeifer R, Buhl-Griesshaber V, Müller U, Wesche H, et al. (2007) Burnout and effort-reward-imbalance in a sample of 949 German teachers. Int Arch Occup Environ Health 80: 433-441

van Vegchel N, de Jonge J, Bosma H, Schaufeli W (2005) Reviewing the effort-reward imbalance model: drawing up the balance of 45 empirical studies. Soc Sci Med 60: 1117-1131

van Vegchel N, de Jonge J, Meijer T, Hamers JPH (2001) Different effort constructs and effort-reward imbalance: effects on employee well-being in ancillary health care workers. J Adv Nurs 34(1): 128-136

Tables

Table 1: Means and standard deviations of ERI and OVC values for ERI and OVC stress groups at T2 and T3

	Effort-reward imbalance (ERI) Stress groups				
	A	**B**	**C**	**D**	Total
	(n = 272)	(n = 52)	(n = 65)	(n = 44)	(n = 433)
Scale	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
ERI T2	0.65 (0.15)	1.16 (0.22)	0.72 (0.16)	1.27 (0.27)	0.78 (0.29)
ERI T3	0.63 (0.16)	0.67 (=.17)	1.21 (0.34)	1.28 (0.34)	0.79 (0.34)
	Overcommitment (OVC) Stress groups				
	A	**B**	**C**	**D**	Total
	(n = 308)	(n = 49)	(n = 40)	(n = 36)	(n = 433)
Scale	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
OVC T2	2.00 (0.43	3.00 (0.18)	2.27 (0.39)	3.18 (0.30)	2.23 (0.58)
OVC T3	1.94 (0.42)	2.29 (0.35)	3.01 (0.22)	3.17 (0.27)	2.18 (0.58)

Table 2a: Means and standard deviations in HADS-D Anxiety and Depression Scale, Satisfaction with Life, physical and mental well-being scales depending on stress groups (N = 433), results of analyses of variance and covariance (covariates: gender and measurements at baseline)

Effort-reward imbalance						
	Stress groups					
	A	**B**	**C**	**D**		Bonferroni multiple comparisons
	(n = 272)	(n = 52)	(n = 65)	(n = 44)		
Scale (at T3)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	p	
Anxiety	4.74 (3.22)	4.29 (2.64)	6.32 (3.60)	6.82 (3.74)	**<0.001**	C,D>A,B
- Value 8-10 n (%)	35 (13)	4 (8)	15 (23)	10 (23)		
- Value ≥ 11 n (%)	14 (5)	2 (4)	9 (14)	7 (16)		
Depression	3.07 (2.64)	2.75 (2.21)	4.69 (3.29)	6.23 (4.00)	**<0.001**	D>C>A,B
- Value 8-10 n (%)	12 (4)	1 (2)	9 (14)	6 (14)		
- Value ≥ 11 n (%)	5 (3)	0	5 (8)	9 (20)		
Satisfaction with life	63.8 (29.3)	58.6 (26.9)	49.9 (29.0)	38.6 (34.2)	**<0.001**	D<C<A,B
Physical well-being	5.67 (1.26)	5.65 (1.06)	5.00 (1.41)	4.86 (1.52)	**<0.001**	C,D<A,B
Mental well-being	5.49 (1.34)	5.69 (0.96)	4.48 (1.58)	4.52 (1.66)	**<0.001**	C,D<A,B

Multivarate analysis of covariance			
Wilk's Lambda	F(15,1143)	P	Partial eta squared
0.86	4.19	<.001	0.05

Legend:
A (T2 not high values / T3 not high values)
B (T2 high values / T3 not high values)
C (T2 not high values / T3 high values)
D (T2 high values / T3 high values)

Table 2b: Means and standard deviations in HADS-D Anxiety and Depression Scale, Satisfaction with Life, physical and mental well-being scales depending on stress groups (N = 433), results of analyses of variance and covariance (covariates: gender and measurements at baseline)

	Overcommitment					
	Stress groups					
	A	**B**	**C**	**D**		Bonferroni multiple comparisons
	(n = 308)	(n = 49)	(n = 40)	(n = 36)		
Scale (at T3)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	p	
Anxiety	4.15 (2.74)	5.53 (2.82)	8.57 (3.37)	9.00 (3.55)	**<0.001**	C,D>B>A
- Value 8-10 n (%)	29 (11)	6 (12)	18 (45)	11 (31)		
- Value ≥ 11 n (%)	8 (3)	3 (6)	8 (20)	13 (37)		
Depression	2.84 (2.62)	4.06 (2.65)	6.13 (3.00)	6.56 (3.67)	**<0.001**	C,D>B>A
- Value 8-10 n (%)	12 (4)	3 (6)	6 (15)	7 (19)		
- Value ≥ 11 n (%)	6 (2)	2 (4)	6 (15)	5 (15)		
Satisfaction with life	63.1 (29.6)	61.4 (25.9)	37.8 (25.4)	37.1 (33.8)	**<0.001**	C,D<A,B
Physical well-being	5.68 (1.23)	5.65 (1.18)	4.83 (1.26)	4.39 (1.63)	**<0.001**	C,D<A,B
Mental-well being	5.57 (1.28)	5.37 (1.29)	3.85 (1.39)	4.03 (1.52)	**<0.001**	C,D<A,B

Multivarate analysis of covariance			
Wilk's Lambda	F(15,1151)	p	Partial eta squared
0.80	6.42	<.001	0.07

Legend:
A (T2 not high values / T3 not high values)
B (T2 high values / T3 not high values)
C (T2 not high values / T3 high values)
D (T2 high values / T3 high values)

Table 3: Counts and percentages within ERI and OVC stress groups

Stress groups		**OVC A**	**OVC B**	**OVC C**	**OVC D**	Total
ERI A	n	217	22	19	14	272
	% within ERI	79.8	8.1	7.0	5.1	100.0
	% within OVC	70.5	44.9	47.5	38.9	62.8
ERI B	n	32	14	4	2	52
	% within ERI	61.5	26.9	7.7	3.8	100.0
	% within OVC	10.4	28.6	10.0	5.6	12.0
ERI C	n	39	8	11	7	65
	% within ERI	60.0	12.3	16.9	10.8	100.0
	% within OVC	12.7	16.3	27.5	19.4	15.0
ERI D	n	20	5	6	13	44
	% within ERI	45.5	11.4	13.6	29.5	100.0
	% within OVC	6.5	10.2	15.0	36.1	10.2
Total	n	308	49	40	36	433
	% within ERI	71.1	11.3	9.2	8.3	100.0
	% within OVC	100.0	100.0	100.0	100.0	100.0

Chi-square = 58.06, df = 9, $p < 0.001$